Inga fagifolia (L.) Willd. Guamá

Leguminosae (Mimosoideae) Legume family

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John K. Francis

Inga fagifolia (L.) Willd., commonly known as guamá (Spanish), sweet-pea and Spanish oak (English), and pois doux (French), is a medium-sized (fig. 1) evergreen tree native to the Greater and Lesser Antilles. It is common in moist and wet forests, especially secondary forests. The tree is still used to some extent as a coffee shade tree and is sawed for lumber.

HABITAT

Native Range

The native range of guamá (fig. 2) includes the Greater Antilles, except Cuba, where it is naturalized (*5*); the Virgin Islands; Antigua; Saba; St. Kitts; Montserrat; Guadeloupe; Marie Galante; Dominica; Martinique; St. Vincent; Grenada; Barbados in the Lesser Antilles; and Trinidad (*13, 16*). The distribution usually ascribed to guamá in Venezuela (*24*) may actually be that of other species of *Inga,* as is the distribution of what was once thought to be guamá in Mexico and Central America (*13*).

Climate

Guamá is adapted to moist and wet forests, with mean annual rainfall from 1400 to 3500 mm. The species also grows in drier areas on alluvial soils along perennial or intermittent streams. Dry seasons of up to 3 months are a feature of the climate of most of the islands where guamá grows. Mean annual temperatures within the native range of guamá range from about 23 to 26 °C, depending mainly on altitude. Temperatures rarely exceed 32 °C or drop below 15 °C. Frosts are unknown in the native range of guamá.

Soils and Topography

Guamá is able to grow on a wide variety of soils and sites, including soils with textures from sands to clays (*20*). The species grows on soils originating from many kinds of parent material. Soil pH at least as low as 5.0 and moderately low levels of exchangeable cations seem to be adequate for guamá. Soils can be poorly drained, but not swampy. Excessively drained soils due to sand or skeletal rock or shallow soils in areas of minimum rainfall will not support the species. Guamá grows on both steep and level topography from a few meters above sea level to over 1,000 m in elevation.

John K. Francis is a research forester at the International Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Río Piedras, PR 00928-2500; in cooperation with the University of Puerto Rico, Río Piedras, PR 00936-4984.

Associated Forest Cover

In a subtropical wet forest stand dominated by *Dacryodes excelsa* Vah., *Euterpe globosa* Gaertn., *Cecropia schreberiana* Miq., *Micropholis garcinifolia* Pierre, *Slonea berteriana* Choisy, *Cyrilla racemiflora* L., and *Magnolia splendens* Urban, guamá contributed only 72 of a total of 3,100 stems (*25*). In another subtropical wet forest dominated by *C. racemiflora* L., *Micropholis garcinifolia,* and *Magnolia splendens,* guamá contributed 28 of 3,400 stems (*25*). Guamá, *Inga vera* Willd., *Guarea guidonia* (L.) Sleumer, *Andira inermis* (W. Wright) H.B.K., and *Cecropia*

Figure 1—*The trunk of a guamá,* Inga fagifolia *(L.) Willd., tree growing in Puerto Rico.*

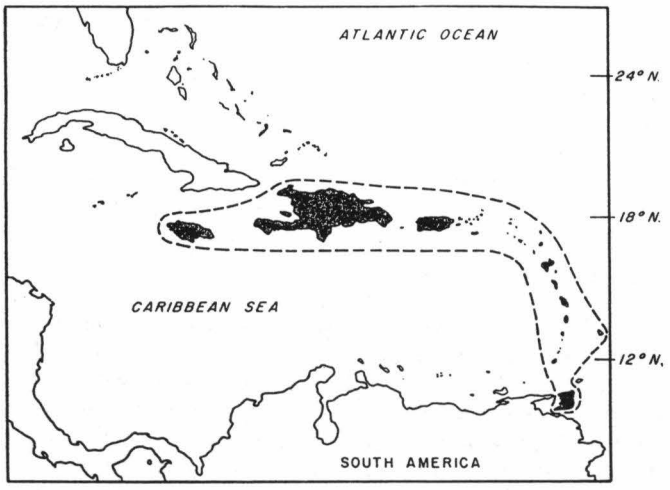

Figure 2.—*The native range of guamá,* Inga fagifolia *(L.) Willd., in the West Indies is indicated by the shaded area.*

schreberiana, are the principal species composing the secondary forests arising from abandoned shaded coffee plantations (*28*). Additional examples of species associated with guamá can be found in *2, 3, 6, 18,* and *27.*

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—The flower spikes are white and brushlike, 8 to 15 cm long, and borne singly or in pairs. The flat pods, 6 to 12 cm long and 2 to 3 cm wide, contain several seeds (*16*). Guamá, as a species, flowers and fruits throughout the year (*16*), although individual trees may be episodal in flowering and fruiting.

Seed Production and Dissemination.—Seeds for propagation may be collected by clipping ripe pods from trees or by picking them up from the ground under bearing trees. As pods ripen, they change color from green to yellow to brown. The testa of the seed is thin and leathery. The seeds will not retain their viability if dried. There were an average of 1,120 seeds per kg of fresh seeds in one sample from Puerto Rico (*12*). It is best to sow the seeds immediately after collection, but if this is not possible, the whole pods may be refrigerated for a few days without damage to the seeds. The seeds are dispersed by bats and birds that feed on the pods and/or the small amount of pulp surrounding the seeds. These animals may, in the process of feeding, carry the pods some distance from the mother tree (*9, 20*).

Seedling Development.—Germination is hypogeal. In one trial, germination began about 5 days after sowing and continued for 17 days (author, personal observation). Germination rates of 96 percent were observed in Puerto Rico (*12*), and rates of 80 percent, in Trinidad and Tobago (*20*). After germination under shade, the stems elongate about 6 cm before fully developing the first pair of leaves (author, personal observation). Grown under shade, a group of containerized seedlings reached an average height of 22 cm in 8 months after sowing. That nursery period could probably be shortened by growing seedlings in full sun. Because about 6 months elapse before rapid growth begins in out-planted seedlings, it is advisable to use seedlings that are at least 50 cm in height to reduce the danger of the seedlings being smothered by weeds.

Vegetative Reproduction.—Small guamá trees will coppice, but large trees will not (*20*). It is not known whether cuttings can be rooted or if grafting can be successfully performed.

Sapling and Pole Stage to Maturity

Growth and Yield.—A solid planting of 52 potted seedlings in a small opening in moist forest grew an average of 1 m in the first 12 months, and another meter in the next 9 months. Survival was 98 percent at the end of 1 year and 96 percent at 21 months (author, personal observation). Guamá trees measured in late secondary forests in Puerto Rico showed mean annual diameter increments of about 0.5 cm per year over an 18-year period. Mean annual diameter increments for individual trees varied from undetectable to 1.2 cm (*7*). The largest guamá known in Puerto Rico measures 89.3 cm in d.b.h. and 21.5 m in height.[1] It is a former shade tree in an abandoned coffee plantation in the Luquillo Mountains, and it is at least 60 years old.

Rooting Habit.—Because of its deep and intertwining root habit, guamá was recommended for streambank stabilization in the Dominican Republic (*22*). Guamá roots are endomycorrhizal, and they produce nodules, presumably associated with *Rhizobium* bacteria (*10*).

Reaction to Competition.—Guamá is intermediate in tolerance to intolerant of shade. Seedlings will survive light to medium shade. Seedlings established by direct seeding under shade averaged 36 and 76 cm in height after 1 and 2 years, respectively. Corresponding heights of seedlings grown in full sun averaged 40 and 122 cm after 1 and 2 years (*20*). Adult trees retain vigor surprisingly well in lower canopy positions. Guamá trees in dominant, codominant, intermediate, and suppressed crown positions in late secondary, subtropical wet forest grew 0.77, 0.52, 0.33, and 0.19 cm/yr in d.b.h., respectively, over an 18-year period (*7*). In one experiment in Puerto Rico, two thinnings over an 18-year period resulted in an increase in average annual diameter increment from 0.38 to 0.47 cm/yr for guamá in secondary forest stands (*26*).

Although widely distributed, guamá normally constitutes only a small percentage of the total basal area of the forests where it grows. In a survey of the timber of privately owned secondary forests in moist portions of Puerto Rico, guamá ranked fifth of the species encountered in terms of basal area and accounted for 1.2 percent of the total basal area (*4*).

It is sometimes necessary to remove guamá trees because of poor form or low market value during timber stand improvement and cleaning operations. In a test of 46 trees, 80 percent were dead a year after frill girdling and treatment with 2,4,5-trichlorophenoxyacetic acid (2,4,5-T)[2] in diesel oil (*23*).

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[1]Champion tree register of Puerto Rico. On file with: International Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Río Piedras, PR 00928-2500.

[2]This herbicide is banned for silvicultural use in the United States by the U.S. Environmental Protection Agency.

Damaging Agents.—The most serious pest of guamá in Puerto Rico is the hormiguilla, an ant *(Myrmelachista ambigua ramulorum* Wheeler) that tunnels in live branches and trunks. This ant tends aphid species *Pseudococcus citri* Risso and *Cryptostigma inquilina* Newstead that suck the sap of the host tree and secrete a sweet nectar (*19*). Mortality was so high and growth so slow that in the 1920's and 1930's it caused a decline in coffee yields across Puerto Rico and resulted in growers switching to other species for coffee shade. There are great numbers of other insects that feed on guamá, generally with insignificant effects (*21*). A wilt disease called "mal de guaba," serious in *I. vera,* occasionally attacks guamá (*19*).

A survey of sawtimber on privately owned secondary forest lands in Puerto Rico found 38 percent of the guamá sawtimber free of defects, 35 percent with poor form, and 12 percent with stem cankers. It was estimated that only 8 percent of the wood volume was unsound (rotten) (*1*). Guamá logs are quickly attacked by pinhole borers, but resist sapstain fungi (*17*). The wood in use is susceptible to termites and decay. The service life of untreated guamá posts is 1.5 to 1.6 years, but treated with pentachlorophenol[3] in diesel oil, the service life is extended to 6 to 10 years (*8, 11*).

SPECIAL USES

At one time, guamá was the most popular shade tree for coffee production in Puerto Rico. Because of severe attacks by the hormiguilla, other shade tree species, particularly *I. vera,* are now favored (*19*). The small amount of white pulp surrounding the seeds is very sweet and is sometimes eaten by children. Livestock readily consume the pods (*14*). The flowers are an important source of nectar for honeybees (*16*).

One of the reasons that guamá was extensively planted as coffee shade is because it fixes nitrogen through symbiotic association with *Rhizobium* bacteria in its root nodules. It has also been shown that nitrogen fixation takes place through an unknown mechanism in the lenticular bark (*29*).

Guamá heartwood is pale reddish brown, often streaked with darker brown. The sapwood is not clearly distinguished from the heartwood. Samples of heartwood of six guamá trees in Puerto Rico averaged ovendried weights of 0.64 ± 0.02 g/cm^3 (author, personal observation). Guamá wood seasons rapidly with moderate degrade, shrinking 1.6 percent tangentially and 2.7 percent longitudinally (*17*). It works easily and finishes well. Guamá wood is suitable for furniture, cabinets, veneer, construction, and flooring, but because in Puerto Rico there are few logs of any species sawed, it is seldom used for any of these purposes. Guamá is used occasionally to make charcoal and posts.

GENETICS

Inga is a genus of about 200 species in tropical America (*13*). *Inga laurina* (Sw.) Willd. is a botanical synonym for guamá (*15*).

[3]The production and use of pentachlorophenol is now banned in the United States. Other treatments would probably result in somewhat shorter service lives.

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